

## **Solar Irradiance Variability**

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Solar irradiance varies at all wavelengths and on all time scales measured thus far. Space observations of the Sun during the past two decades have observed total, UV spectral and X-ray irradiance with sufficient precision to characterize 27-day rotations and the 11-year solar cycle. Magnetic features (dark sunspots, bright faculae, hot coronal loops) are known to be primary sources of irradiance variability. Models of active regions and network in the solar atmosphere successfully replicate much of the observed irradiance variability during the contemporary epoch and provide, as well, estimates of spectrum changes at visible, infrared and extreme ultraviolet wavelengths where the observations are sparse. A model of total irradiance based on sunspot darkening and facular brightening accounts for a significant fraction (88%) of variance in a composite observational record from 1978 to 1996. But in the ascending phase of cycle 23 discrepancies in annual trends between the model and measurements, and among the measurements themselves, exceed 100 ppm. Irradiance changes on centennial time scales are speculated to exceed solar cycle amplitudes, consistent with indirect terrestrial proxies of solar activity (cosmogenic isotopes and geomagnetism) and the range of variations in Sun-like stars but actual physical connections between terrestrial proxies and irradiance remain to be quantified. Various historical reconstructions based on different assumptions about long-term irradiance trends differ from each other, and also in their ability to replicate the observational record in recent decades.